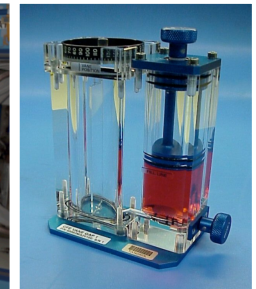
Capillary Flow Experiments-2 (CFE-2)

Glenn Research Center

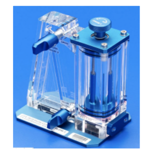
PI: Prof. Mark Weislogel, Portland State University
PS: Robert Green, NASA GRC
PM: Donna Bohman, NASA GRC
Engineering Team: ZIN Technologies, Inc.

Sunita Williams performing ICF2 ops in Increment 15.



Vane Gap1&2

Interior Corner Flow 1



Interior Corner Flow 2

Objective:

- The objective of CFE-2 is to investigate the role of capillary forces in the transport and storage of fluid systems in space. Capillary forces can be exploited to control fluid orientation to enable predictable performance for large mission critical systems involving fluids.

Relevance/Impact:

- Technologies in space use capillary forces to position and transport fluid. CFE-2 provides improved design knowledge in the storage and transport of liquids in space thereby increasing system reliability, decreasing system mass, and reducing overall system complexity.

Development Approach:

- CFE-2 consists of eleven (~2.0kg) test vessels designed to probe capillary flow in complex containers, critical wetting in discontinuous structures and surfaces, and passive gas-liquid phase separations.
- Four of the eleven vessels require simple, quick adaptations to existing flight hardware. The remaining seven units are new designs based on the CFE Interior Corner Flow (ICF) test results. Stepped (ICF3&4), porosity gradient (ICF5&8), and internal vane tapers (ICF6,7,9) will measure the test vessel geometries effect on time dependent flows as well as their passive phase separation characteristics.
- Highly quantitative video images of the crew performed procedures provide immediate confirmation of the usefulness of current analytical design tools, as well as provide guidance to the development of new ones.
- Samples will be launched on two separate flights; ULF-3 and 19A.
- All of the experiments contain small volumes of zero hazard fluids, require no electrical interface, and use the same general set-up, camera alignment, focus, lighting fluid fill, expected experiment fluid response and operation timeframes. Operations are performed on the MWA in the Destiny Module on ISS.

ISS Resource Requirements

Accommodation (carrier)	**Maintenance Work Area (MWA)**
Upmass (kg) (w/o packing factor)	20
Volume (m^3) (w/o packing factor)	0.036
Power (kw) (peak)	N/A
Crew Time (hrs) (installation/operations)	35
Autonomous Ops (hrs)	N/A
Launch/Increment	ULF3 and 19A

Project Life Cycle Schedule

Milestones	**SCR/ RDR**	**RDR/ PDR**	**VRR**	**Phase III Safety Review**	**FHA**	**Launch**	**Ops**	**Return**	**Final Report**
Actual/ Baseline	06/08	08/08	N/A	3/2009	06/2009	09/2009, ULF-3	Inc. 21	Inc. 22	2010
					11/2009	01/2010, 19A	Inc. 22	Inc. 23	2011
Documentation	Website: http://exploration.grc.nasa.gov/Advanced/ISSResearch/MWA/CFE/ eRoom:https://collaboration.grc.nasa.gov/eRoom/NASA c1f1/CapillaryFlowExperiments			SRD: Draft 04/2008 (see website) EDMP: (see eRoom)		Project Plan: (see eRoom) SEMP: to be developed			